

Aug. 21, 1928.

A. L. NELSON

1,681,621

PISTON

Filed June 22, 1927

2 Sheets-Sheet 1

Fig. 1.

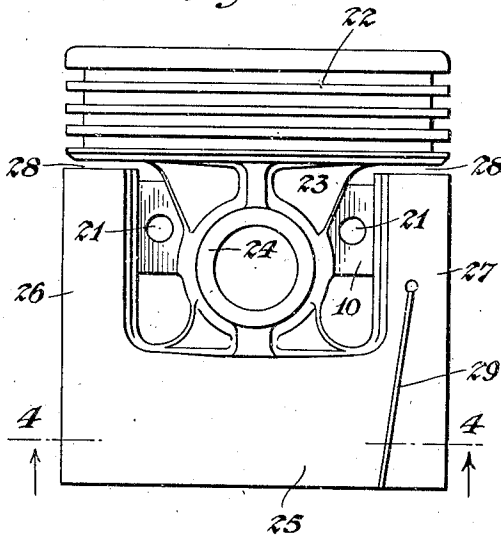


Fig. 2.

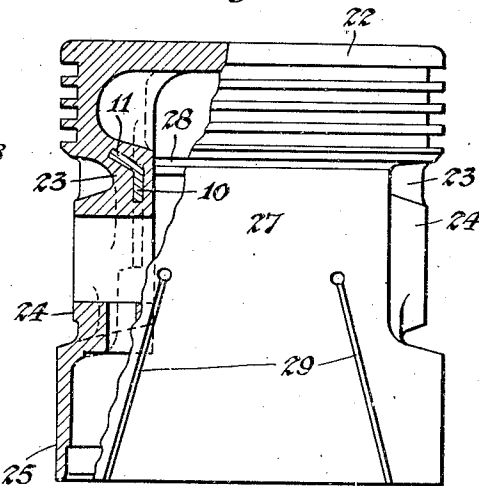


Fig. 3.

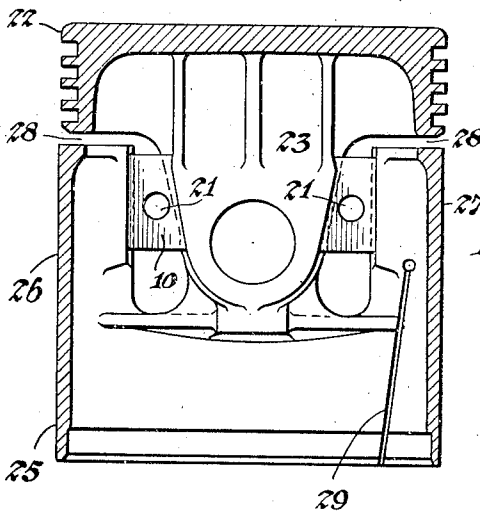
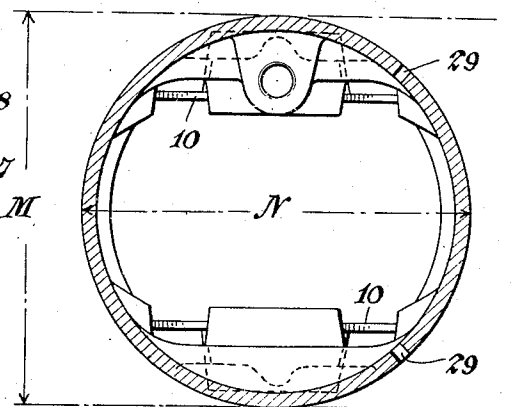


Fig. 4.



Adolph L. Nelson INVENTOR
BY Frank Hunt ATTORNEY

Aug. 21, 1928.

1,681,621

A. L. NELSON

PISTON

Filed June 22, 1927

2 Sheets-Sheet 2

Fig. 5.

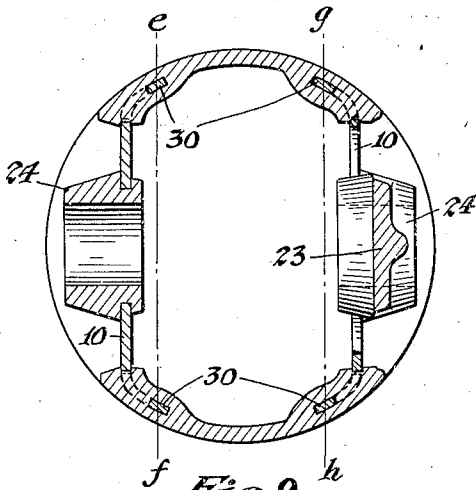


Fig. 6.

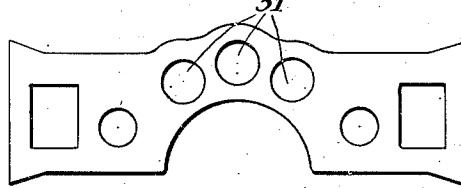


Fig. 7.

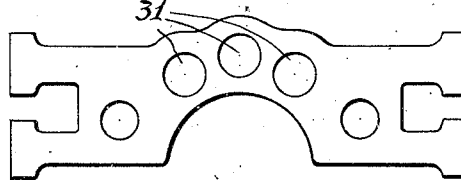


Fig. 8.

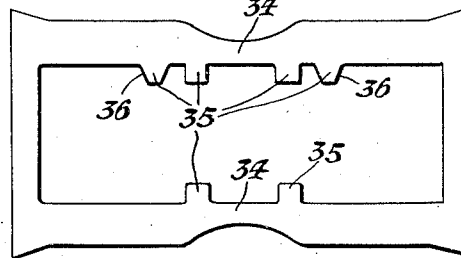


Fig. 9.

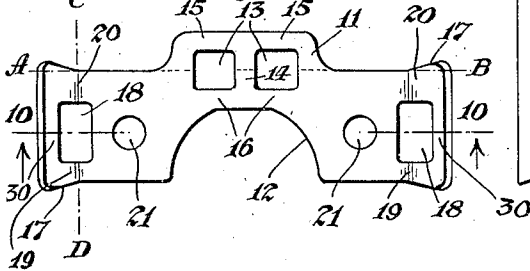


Fig. 10.

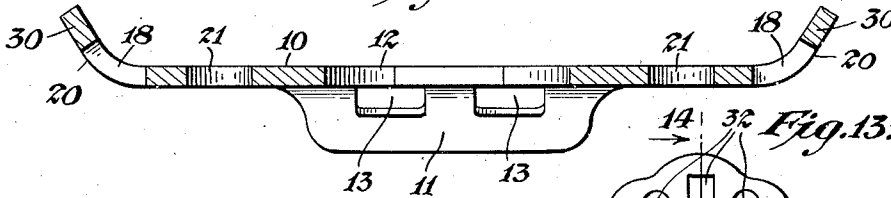


Fig. 11.

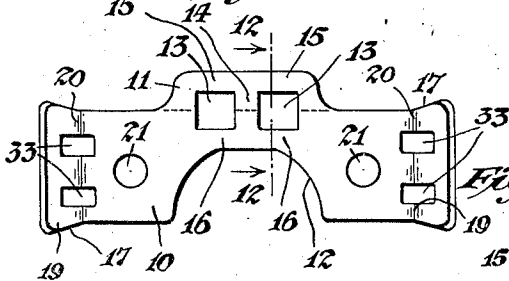


Fig. 12.

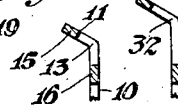


Fig. 14.

INVENTOR
Adolph L. Nelson
BY
Frank J. Hunt
ATTORNEY

UNITED STATES PATENT OFFICE.

ADOLPH L. NELSON, OF DETROIT, MICHIGAN, ASSIGNOR TO BOHN ALUMINUM & BRASS CORPORATION, OF DETROIT, MICHIGAN.

PISTON.

Application filed June 22, 1927. Serial No. 200,534.

This invention relates to pistons of the type in which the skirt is braced by a pair of chordal struts and aims to improve the construction and method of manufacture of such pistons.

A particular object is the provision of a method of manufacture in which casting strains are utilized for giving the parts of the piston a suitable fit within the cylinder. This is accomplished by first casting the skirt about the struts to produce casting strains, then grinding it and afterward slitting it in such a way as to relieve certain of the strains and cause parts of the skirt to become deformed to the desired extent.

A further object is to improve the construction of the struts to give them better cast-in joints with the material comprising the rest of the piston, and to permit them to yield with the expansion and contraction of the piston material. The joints at the ends of the struts are arranged so that the neutral points of opposite joints may be given any desired spacing regardless of the spacing of the main part of the strut bodies.

As to the combination of the chordal struts buried in the piers with homogeneous ties connecting the cylinder-bearing portions and the piers, the present application is a continuation of application Serial No. 643,499, filed June 5, 1923. For the combination of the chordal struts buried in the piers with homogeneous ties connecting the cylinder-bearing portions and the piers and a slot extending upward from the bottom of the piston into one of the cylinder-bearing portions, the present application is a continuation of application Serial No. 35,703, filed June 8, 1925.

In the drawings:

Fig. 1 is a side elevation of a piston embodying the invention.

Fig. 2 is an elevation partly in section looking from the right of Figure 1.

Fig. 3 is a longitudinal section of the piston.

Fig. 4 is a section on line 4—4 of Fig. 1.

Fig. 5 is a section taken through the struts.

Fig. 6 is a plan of a strut blank before bending.

Fig. 7 is a view similar to Fig. 6 showing a modified form of strut.

Fig. 8 shows another type of strut.

Fig. 9 shows further modification of strut structure, partly bent to finished shape.

Fig. 10 is a section on line 10—10 of Fig. 9, after the strut has been bent to finished shape.

Fig. 11 is a view similar to Fig. 9 of a different form of strut.

Fig. 12 is a section on line 12—12 of Fig. 11 after the strut has been bent.

Fig. 13 is a view similar to Fig. 9 of an additional type of strut.

Fig. 14 is a section on line 14—14 of Fig. 13, after full bending has been completed.

The piston comprising this invention is preferably formed of light-weight material, such as an aluminum alloy, and comprises in general a head portion and a skirt portion which are separated throughout the major portion of the circumference of the piston but are joined by vertical piers integral and homogeneous with the head and skirt.

The strut used in the piston is made from any suitable material, such as steel, relatively inexpandable as compared with the piston material, and comprises a flat, plate-like body 10 formed with an upward extension 11 at its central part. Below the extension 11 a semi-circular notch 12 is formed in the lower edge of the strut, and apertures 13 are cut through the body above the notch 12. These apertures 13 are of such a size that the bar 14 which separates the apertures, as well as the bars 15 and 16 above and below them are relatively narrow for a purpose to be hereinafter explained. The struts have slightly flaring ends as at 17, and an aperture 18 is cut through the body near the end in such a position that the bar 19 on the notched side of the body is thinner than the bar 20 on the opposite side of the body. The ends of the strut are bent forward along lines C—D (Fig. 9) while extension 11 is bent to the rear on line A—B. The strut has a pair of positioning apertures 21 formed through its body.

The pistons are preferably cast in permanent molds, and the first step in the casting process is to place a pair of struts in position in the mold with their notched sides uppermost. The apertures 21 are engaged over projections formed on the mold to thereby accurately position the struts and to

hold them firmly against movement in any direction. The molten piston metal is then poured into the mold, which is shaped in such a way that the metal flows around the center and ends of the struts, but leaves the intermediate parts free, as will be clear from Figs. 1-5.

When the hot metal enters the mold it is very fluid and as it rises it flows readily around the relatively thick bar 20, but it cools very rapidly and loses its fluidity so that by the time it reaches the bar 19 it would have difficulty in flowing around it to form a perfect joint if this bar were not made relatively narrow, as explained above.

As the piston cools after casting, the aluminum shrinks faster than the strut material, and there is a natural tendency for the aluminum to draw away from the sides of the strut at its center. By shaping the strut so that the aluminum surrounds narrow bars of the strut, as 14, 15, 16, the aluminum is held tightly to the sides of the strut by the heavy ties of aluminum formed about the bars.

After casting, the piston comprises a head 22, piers 23 depending from the head and having piston pin bosses 24 formed therein, a lower circular portion 25 homogeneous with the piers, and semi-cylindrical bearing portions 26 and 27 located between the pin bosses and homogeneous with the head and with the circular portion 25.

The differential shrinking of the skirt and strut materials after casting sets up certain shrinkage strains and distortion in the skirt owing to the tendency of the strut to resist the skirt shrinkage along certain lines, while the skirt shrinkage is unopposed along other lines. As a result the diameter M at the extreme bottom of the skirt (Fig. 4) contracts faster than diameter N due to the effect of the struts in holding the upper part of the skirt out along diameter N, and thereby distorting the lower end of the skirt.

The next step in the formation of the piston is to sever the upper ends of the semi-cylindrical bearing portions from the head by saw cuts 28, leaving the head free to expand under the heat of operating conditions without affecting the bearing portions. The piston is then passed through a grinding operation to place the desired finish on the outside of the skirt surfaces.

The slots 29 are now cut upwardly from the bottom of the skirt into the bearing portion 27. The lower end of each slot is approximately below a lateral margin of the bearing portion, and the upper ends of the slots converge toward each other and are located above the lower ends of the recesses separating the bearing portion from the piers. Cutting these slots relieves some of the casting strains and as a result the lower part of bearing portion 27 lying between the slots 29 springs outwardly increasing slightly

the width of the skirt on diameter N, while at the same time the parts of the circular portion 25 that lie below the pin bosses spring inwardly, thereby decreasing the width of the skirt on diameter M. If the upper ends of the slots are placed closer together the portion between the slots will be more flexible, while if the slots are made shorter the bearing portion will spring out less. These proportions are designed so that the piston will suit the cylinder fit condition desired, although generally they are made to give an increase of about .0035 in. on diameter N and a decrease on diameter M of about half that amount.

The skirt slotting disclosed herein has several important advantages. The method of manufacture is simplified by reason of the fact that the slots can be cut after the grinding operation has been finished. The piston can be run with a minimum of power loss due to friction since the bottom of the skirt under the pin bosses is given the much needed extra clearance and the upper part of the skirt can be given a relatively loose fit in the cylinder, the sprung-out portion preventing piston slap.

Due to its close fit, the bottom end of the skirt "wipes" the bore of the cylinder for a considerable portion of its circumference and helps to keep the oil down.

Referring to Fig. 5 it will be seen that the aluminum of the skirt completely surrounds the bar 30 at the end of the strut, and that the neutral points of the joints between the ends of the struts and the skirt fall on the lines $e-f$ and $g-h$, which lines are closer together than the lines representing the axes of the strut bodies. By giving a correct length to the curved end of the strut it is possible to produce a desired rate of skirt expansion regardless of the spacing of the main bodies of the struts, since it is the distance between the lines $e-f$ and $g-h$, that is an important factor in determining the expansion rate of the skirt. This structure of the strut end also contributes to a better grip between strut and skirt, and helps to let the metal shrink towards the neutral point of the joint.

The outward bend given to the strut extension 11 permits the strut to yield with the expansion and contraction of the piston metal and helps to maintain a tight grip of the pier about the strut.

Fig. 6 shows a modified strut blank in which a plurality of round holes 31 provide means for forming a firm bond between the piers and the strut.

The blank of Fig. 7 is similar to that of Fig. 6 except that the end bars have been severed to form a plurality of T heads on each side of the strut.

The blank shown in Fig. 13 is similar to that shown in Fig. 9 except that its central

part is pierced by three elongated openings 32, this structure being useful wherever a wide strut is advisable.

5 As shown in Fig. 11 a number of apertures 33 may be placed in the ends of the strut to produce a plurality of aluminum ties extending around the end bar.

10 Fig. 8 illustrates a blank for an open frame type of strut in which the central part of the horizontal bars are formed thin as at 34 to permit a close aluminum bond being formed thereabout. The projections 35 help to anchor the strut against movement in the pier, while the faces 36 are used to locate and hold the strut horizontally in the mold.

I claim:—

20 1. A piston having a head, piers depending from the head, piston pin bearings formed in the piers, cylinder-bearing portions on opposite sides of the piston, a pair of chordal struts, each of said struts extending between the cylinder-bearing portions, the intermediate portion of each strut being surrounded by the material of a pier, there being an integral connection between

each of the cylinder-bearing portions and each pier, said integral connection being in addition to the struts and being continuous and homogeneous with the cylinder-bearing portions and the piers. 30

2. A piston having a head, piers depending from the head, piston pin bearings formed in the piers, cylinder-bearing portions on opposite sides of the piston, the head and cylinder-bearing portions being formed of relatively light weight metal, a pair of chordal struts, each of said struts being formed of material less expansible than that of the head and extending between the cylinder-bearing portions, the intermediate portion of each strut being surrounded by the material of a pier, there being an integral connection between each of the cylinder-bearing portions and each pier, said integral connection being in addition to the struts and being continuous and homogeneous with the cylinder-bearing portions and the piers. 40 45

In testimony whereof I affix my signature.

ADOLPH L. NELSON.